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died, when he was seventy-eight years old, Professor Ludwig wrote to me to say that he would take into his laboratory a young American whom I had recommended. Beginning the letter with a charming, fanciful sketch of the way my new house must look and the wish that he might be there with us, he ran into a soberer vein and wrote:

Destiny has conferred on us professors the favor of helping the responsive heart of youth to find the right path. In the seemingly insignificant vocation of the schoolmaster there is enclosed a high, blessed calling. I know no higher. In its fulfilment you will be the happier the more you yourself grow in knowledge and power of thought, the more you endeavor to be suited to the profession. How glad I am of your present and future happiness.

Ludwig died in his seventy-ninth year, in Leipzig, April 27, 1895. His wife wrote us:

Our daughter had come to us to help care for her father, and we were both by him day and night. Seven weeks he lay sick, but his mind was always clear. Only a few days before his death his thoughts were busied with a paper which he wished to write on his dead friend Helmholtz. On the last evening he still asked us about many things in which he was interested, then complained of great fatigue and so softly slept. The hastily called physician could only tell us that a sudden heart failure had quickly and painlessly ended his life.

No better words can be spoken at the end of an account of Ludwig's life, than those which he used at the close of his *Gedächtnissrede* for Ernst Heinrich Weber:

Now that he has departed from us, he has left us a rich heritage, but inestimable good has sunk into the grave with him. The one on whom his soulful eyes rested, who listened to the flow of his thoughtful words, who felt the pressure of his hand, will always long for him. Yet not only the friend, each one who in life and in science came in contact with his power, will mourn the death of a man, in whom were mingled in complete har-

mony, a spirit as clear as his and a nature of such richness.

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ANIMAL LIFE AS AN ASSET OF NATIONAL PARKS¹

THE argument most frequently urged in favor of national parks is that they provide on a large scale for the protection of forest areas, and thereby ensure the transmission of a maximum water supply from the wooded tracts to the needy lands below. Attention has also been called to their value as refuges for wild life—particularly where the animals to be conserved are useful for game or food. The strict protection they afford enables the birds and mammals within their boundaries to reproduce at a maximum rate, and the surplus thus created, spreading outwards into adjacent unprotected areas, helps to make up for the depletion caused there by excessive hunting. The points mentioned above are fairly obvious. But national parks have other less generally recognized advantages, and among these we consider their potential uses as places for recreation and for the study of natural history, especially worthy of notice. We will here lay particular emphasis on their recreative value because this phase seems to have hitherto been treated only in a cursory way, and with an air of hesitancy, as if it were hardly deserving of practical consideration.

The term recreation is currently applied to any temporary change of occupation that calls vigorously into play latent or seldom used faculties of the mind and body. It is the purpose of this change to restore to the human organs the normal balance which special or artificial conditions of life disturb. As physiologists have long recognized, the interdependence of the various bodily functions is such that the neglect of one is bound to have its effect on the others, and complete health can only be attained when every function is given its adequate share of exercise. In view of this fact

¹ Contribution from the Museum of Vertebrate Zoology of the University of California.

and of the general character of urban life at present, it would seem that the type of recreation most urgently needed by the majority of people to-day is to be found in the open country. The relatively abrupt changes coincident with modern civilization have seriously interfered with the fine adjustments acquired by the human body in the course of long ages; and the modern business man, who may be regarded as the final and typical product of these changes, can now obtain rest in its fullest sense only by resorting for several weeks in the year to the open country or mountains. There he may find entire relief from the nerve-racking drive of city life, and be brought once more into contact with primitive conditions. There he may have an opportunity of reawakening his dormant faculties and of "resetting" his physical "tone," by effecting a readjustment of physiological inter-relations. One of the greatest needs of city dwelling people is to develop objective interests; "to get out of themselves," as the phrase goes; and a frequently effectual means to this end is a keen interest in outdoor things, encouraging, as it must, a healthy manner of living, an unconfined habit of observation, and a mood unaffected by the nervous tension so peculiar to town life.

If this be true, it follows that the best recreative elements in nature are those which most infallibly tend to revive our atrophied faculties and instincts. Among them the following are important. First: either perfect quiet, or an absence of all save primitive and natural sounds, such as those caused by the wind in the trees, by running or falling water, or by singing birds. Second: landscapes that relieve the eyes from close work by offering distant views, quiet harmonies of color, and a quiescent atmosphere, varied by occasional touches of movement in such objects as running or falling water, scurrying squirrels, or birds in flight. Third: accessible mountains, which encourage climbing and allow the visitor to combine the exhilaration of overcoming obstacles with the physical exercise attending the woodsman's mode of travel. Fourth: natural phenomena that make a purely intellec-

tual or esthetic appeal, as do the conflicts between the great insentient forces of nature, the processes of geological upbuilding and destruction, the intimate inter-relations of plants and animals, and the contentions for mastery that are forever recurring throughout the whole realm of living things. We believe the last, the mental appeal, to be the element of greatest recreative value in nature, but the other three are only of slightly less importance.

The question may now be raised: "Can national parks meet these requirements any more fully than other uncultivated areas?" With the country in its present half developed state the objection has a certain degree of force. In this era one is inclined to think of the unprotected wilds as the silent, virginal and unspoiled regions of the earth, and to regard national parks as comparatively well-peopled areas where plants and animals are subjected to artificial restrictions. To a limited extent, and for the moment, this impression is a true one. But the objection will have less force in the course of a few years, and none whatever if by that time the full recreative possibilities of the parks have been realized. For the commercial exploitation of nature that is now going on so rapidly elsewhere, is daily making the conditions we have described harder to seek, and is confining them more and more closely to the park areas, where the administrators should be taking measures to propagate and conserve them. By this we do not mean that the parks should in any way be conventionalized or transformed. On the contrary, it is their chief function to prevent just that disfigurement of the face of nature by industrial machinery which is being carried on at such a disastrous rate in other localities. We mean rather that the ideal recreative conditions now to be found in them should be preserved, that all factors disturbing to these conditions should be excluded, and that the artificial elements required for the practical work of administration should be disguised or beautified past offense.

Let us, however, take up these points in greater precision and detail. The first neces-

sity in adapting the parks for recreative purposes is to preserve natural conditions. In this respect a national and a city park are wholly different. A city park is of necessity artificial, in the beginning at least when the landscape is planned and laid out; but a national park is at its inception entirely natural, and is generally thereafter kept fairly immune from human interference. Herein lies the feature of supreme value in national parks: they furnish samples of the earth as it was before the advent of the white man. Accordingly, they should be left in their pristine condition as far as is compatible with the convenience of visitors. All necessary roads, trails, hotels and camps should be rendered inconspicuous, or, better still, invisible from the natural points of vantage in the parks. Another reason for retaining primitive conditions is that natural scenery unmarred by man is one of the finest known sources of esthetic pleasure. Any attempt to modify the appearance of a national park by laying out straight roads, constructing artificial lakes, trimming trees, clearing brush, draining marshes, or other such devices, is in the worst of bad taste.

As has already been intimated, the animal life of the parks is among their best recreative assets. The birds and mammals, large and small, the butterflies and the numerous other insects, even the reptiles and amphibians, are of interest to the visitor. As a stimulant to the senses of far sight and far hearing, faculties largely or altogether neglected in the present scheme of civilization, they are of no less consequence than the scenery, the solitude and the trails. To the natural charm of the landscape they add the witchery of movement. As soon as the general surroundings lose their novelty for the observer, any moving object in the landscape will catch his eye and fix his attention. People will walk miles and climb thousands of feet to secure a good view of falling water, and this desire for movement is even more completely satisfied by the sight of animals in motion. The moving deer, passing within range of the stage-coach, rouses exclamations of surprise and delight. Eagles and pigeons in flight overhead readily claim the

traveler's notice, and the smaller birds often mingle the fascination of sprightly movement with that of bright color and pleasing song. Considering the predilections of the average visitor, we should perhaps regard these last as the most indispensable creatures in the parks.

The interest of moving objects depends upon a number of elements other than movement, among which their color, and especially their size, is important. The chipmunk is more attractive than the ground squirrel, primarily because its movements are more rapid, and secondly because of its more brightly colored markings. But when movement and color are equal the average observer's selection seems to have a quantitative basis, though the rarity of the object, and its romantic or other associations affect the equation. A bear or a deer will elicit more interest than a smaller mammal, even though the latter be of a rarer species. There are exceptional cases where an animal's extreme rarity will make it of exceptional interest in spite of its inferior size, but in general the larger species are the more rare, as they are the first to disappear before human invasion. They have therefore a double claim to consideration, and measures should be taken to prevent their numbers from diminishing. After the visitor's initial curiosity has been aroused and his powers of observation developed, he may be trusted to give a closer study to the smaller species.

To realize the greatest profit, therefore, from the plant and animal life of the parks, their original balance should be maintained. No trees, whether living or dead, should be cut down, beyond those needed for building roads, or for practical elimination of danger from fire. The use of wood for fuel in power stations, or even for cooking and heating in hotels and camps, is made unnecessary by the abundant supply of water power everywhere available, and this may be utilized without marring the scenery in the slightest. Dead trees are in many respects as useful as living, and should be just as rigorously protected. The brilliant-hued woodpeckers that render such effective service in ridding the living trees of destructive insects depend in part on

dead trees for a livelihood. In these they find food during the colder months of the year, when the insects elsewhere are in great scarcity. Here, too, they excavate their nesting holes. Some of the squirrels and chipmunks also seek shelter in dead or partially dead trees. Even down timber is an essential factor in upholding the balance of animal life, for fallen and decaying logs provide homes for wild rats and mice of various kinds, and these in their turn support many carnivorous birds and mammals, such as hawks, owls, foxes and martens.

No more undergrowth should be destroyed than is absolutely necessary. To many birds and mammals thickets are protective havens into which their enemies find it difficult to penetrate. Moreover, the majority of the chaparral plants are berry-producers and give sustenance to wild pigeons, mountain quail, robins and thrushes, and to chipmunks and squirrels —this, too, at the most critical time of the year, when other kinds of food are scarce or altogether wanting. The removal of such plant growth will inevitably decrease the native animal life. If any change is to be made at all, it would, indeed, seem preferable to increase the number of indigenous berry-producing plants, especially in the vicinity of camps and buildings. This would compensate for the shrubbery lost in constructing roads and buildings, and would also serve to attract berry-eating species to the points where they might be seen by the largest number of people.

It goes almost without saying that the administration should strictly prohibit the hunting and trapping of any wild animals within the park limits. A justifiable exception may be made when specimens are required for scientific purposes by authorized representatives of public institutions, and it should be remarked in this connection that without a scientific investigation of the animal life in the parks, and an extensive collection of specimens, no thorough understanding of the conditions or of the practical problems they involve is possible. But the visiting public should be warned against injuring, and even against teasing or annoying any of the mammals,

against destroying lizards and snakes (except the rattlesnake), and against disturbing the nests of birds, or their young. In the last instance a very slight disturbance will often lead to subsequent destruction. The principle underlying these suggestions is apparent. The native complement of animal life must everywhere be scrupulously guarded, particularly along the most traveled roads and paths, where the animals are likely to be observed by the greatest number of visitors. It is there that each individual animal is of highest intrinsic value from an esthetic viewpoint.

As a rule predaceous animals should be left unmolested and allowed to retain their primitive relation to the rest of the fauna, even though this may entail a considerable annual levy on the animals forming their prey. We, as naturalists, are convinced that the normal rate of reproduction among the wild non-predaceous species, such as mice and squirrels, has adjusted itself to meet a certain annual draft on their population by carnivorous enemies. Another point worth emphasizing is that many of the predatory animals, like the marten, the fisher, the fox and the golden eagle, are themselves exceedingly interesting members of the fauna, and as their number is already kept within proper limits by the available food supply, nothing is to be gained by reducing it still further. Here again may be recognized the special and intimate relations everywhere existing among the various plants and animals.

The rule that predaceous animals be safeguarded admits of occasional exceptions, according to season, place and circumstance. Coyotes and bob-cats, especially the latter, when they are numerous, are likely to kill a great many grouse, quail, rabbits and squirrels. Cooper and sharp-shinned hawks, and, to a lesser extent, blue jays, are proven menaces to small birds, and it might be advisable to reduce them in the neighborhood of camps and much-traveled roads. Caution, however, should be exercised in doing so, and no step taken to diminish the numbers of any of these predators, except on the best of grounds.

We would urge the rigid exclusion of domestic cats and dogs from national parks. Cats are the relentless enemies of small birds; they are forever on the alert, and in ninety-nine cases out of a hundred can not be trusted, however well fed they may have been at home, to let birds alone. The fact that they readily go wild, that is, quickly revert to a feral state, makes it all the more important that they be kept out of unsettled regions. To admit them would mean adding one more predator to the original fauna, and this would tend to disturb the original balance, by making the maintenance of a normal bird population difficult or impossible.

Equal vigilance should be used to exclude all non-native species from the parks, even though they be non-predaceous. In the finely adjusted balance already established between the native animal life and the food supply, there is no room for the interpolation of an additional species. If pheasants be introduced, and allowed to become established in the wild, the native quail and grouse will inevitably suffer from competition with them at the season of minimum food supply, and will be numerically reduced in consequence. The same is true of elk in competition with the native deer, and of many imported small birds in rivalry with the native varieties. In the latter connection we need only mention the well known instance of the English sparrow. Cattle and sheep are also of importance as elements hostile to natural conditions, but their destructiveness has already been emphasized by foresters.

Thus far we have laid chief stress on the importance of the national parks to recreation, and have shown the necessity, in adapting them for this purpose, of retaining the original balance in plant and animal life. But the same necessity attaches to their adaptation for another end, hardly less important than recreation, namely, research in natural history. As the settlement of the country progresses and the original aspect of nature is altered, the national parks will probably be the only areas remaining unspoiled for scientific study, and this is of the more significance

when we consider how far the scientific methods of investigating nature then obtaining will be in advance of those now applied to the same study.

As a final requirement, we would urge that provision be made in every large national park for a trained resident naturalist who, as a member of the park staff, would look after the interests of the animal life of the region and aid in making it known to the public. His main duty would be to familiarize himself through intensive study with the natural conditions and interrelations of the park fauna, and to make practical recommendations for their maintenance. Plans to decrease the number of any of the predatory species would be carried out only with his sanction and under his direction. He would be able to establish and supervise local feeding places for birds and mammals during the tourist season, and could do this without in any serious degree altering natural conditions. His acquaintance with the local fauna would enable him to communicate matters of interest to the public in popularly styled illustrated leaflets and newspaper articles, on sign posts, and by lectures and demonstrations at central camps. He would help awaken people to a livelier interest in wild life, and to a healthy and intelligent curiosity about things of nature. Our experience has persuaded us that the average camper in the mountains is hungry for information about the animal life he encounters. A few suggestions are usually sufficient to make him eager to acquire his natural history at first-hand, with the result that the recreative value of his few days or weeks in the open is greatly enhanced.

We have attempted in these columns to emphasize the value of national parks as places for recreation and for scientific research, two of their uses that have been rather commonly overlooked, and to show the importance in both connections of the animal life they contain. If the reasons and instances we have adduced are valid, there is surely ample warrant for saying that the animals in the parks should be given more care and attention than

they are now receiving, and that they should be conserved and utilized to a fuller extent.

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THE REVIVAL OF INTEREST IN BIRD
ANATOMY AT THE UNITED STATES
NATIONAL MUSEUM

VERY well do I remember when the foundation was laid for a department of comparative anatomy at the United States National Museum. It took place some time along in the early eighties, when Professor Baird's splendid régime was at its height and zoological work was at its best at the Smithsonian Institution. My early papers on the osteology of birds had appeared in Hayden's Twelfth Annual of the U. S. Geological and Geographical Survey of the Territories, and, owing to a fulfilment of a promise made by the then surgeon-general of the army, I found myself in the position of curator of the department of comparative anatomy at the old Army Medical Museum on Tenth Street in Washington. Naturally, I desired to follow up my work on the osteology of birds and upon vertebrate anatomy generally. This impulse led me to obtain Professor Baird's permission to examine what the collections at the National Museum contained in the way of material for descriptive purposes, and to look into the matter of the possibility of publishing researches along such lines.

Professor Baird was a man who took an intense personal interest in the labor of all his curators, and it was his habit every day, when he could afford the time to do so, to make a round of the institution for the purpose of encouraging them in their investigations and to learn whether there was anything, in any particular case, that a curator needed to push his investigations forward. He no sooner noticed my interest in bird anatomy than he opened up the way to make it count for science, and for the advancement of work in that particular field. He immediately established a base for such operations by founding a new position for those not on the regular museum staff, but

who were devoting a large share of their time to scientific investigation, with the view of publishing the results of their studies. The late distinguished Dr. Theodore Nicholas Gill and myself were the first two zoologists appointed by Professor Baird to become co-workers under him as "associates in zoology" on the staff of the institution. Shortly after this event, I undertook to examine the collection there of such material as illustrated the morphology of birds. The alcoholic collection contained many specimens of great value; but what interested me most at that time was the collection of bird skeletons. This consisted of a very remarkable, not to say heterogeneous, lot of avian skeletons, none of which were scientifically prepared. Many were roughed out; a large array of them had been cleaned up by the "sand fleas" of the seas that wash our Alaskan possessions, and, finally, not a few of them were sterna of birds saved by bird collectors all over the country while skinning specimens for their collections. To show how valuable some parts of the material were, I may say that, in one little pasteboard box, I found the original chicken skulls used by Charles Darwin in Volume One of his "Animals and Plants Under Domestication" (Figs. 34, 35 and 36), they evidently having been presented to the Smithsonian either by himself or by Mr. Tegetmeier. (How long they had been in that little box I do not know; at this writing they have been placed in a special case in one of the exhibition halls of the new National Museum!)

A great mass of these skeletons had been collected by our northern explorers, as Dall, Elliott, Bean, Nelson, Turner and others, and were in a fairly good condition. All this material was in "original packages," that is, in any old receptacle the collector could lay his hands upon in the field—chiefly empty cigar-boxes, all sorts of pasteboard boxes, boxes that had held ammunition for collectors, etc. All had been stored away and was covered with the dust of time. However, I gave the lot a preliminary going over, and Professor Baird promptly assigned to my department—the department of comparative anatomy—an old